

WATERS MANUFACTURING, INC.

WAYLAND, MASSACHUSETTS

MODEL 361 - CODAX AUTOMATIC KEYS

INSTALLATION AND OPERATING INSTRUCTIONS

I DESCRIPTION

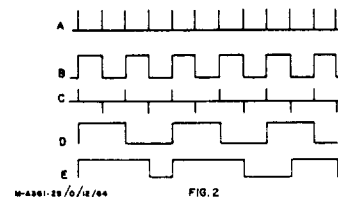
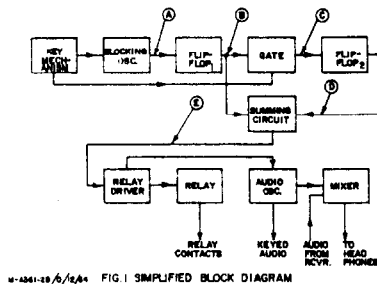
The WATERS Model 361 CODAX AUTOMATIC KEYS is a fully solid-state automatic keyer designed for maximum operator convenience in CW operation. CODAX is a complete unit with its own internal battery power supply and an integral, front panel mounted, double-paddle key. Only two controls are necessary. Speed, (5 - 50 words per minute) and audio gain/"ON"- "OFF" switch. CODAX may be used with any type of transmitter - AM, CW, and SSB, without any modification to the transmitter. Interconnection between CODAX and your transmitter and receiver are by means of simple cables.

Among the novel features of CODAX are:

- 1) Provision for mixing the incoming signal from your receiver with YOUR own keying for monitoring.
- 2) Use of an ultra-reliable REED Relay for keying the transmitter (grid-block keying).
- 3) Provision of a "keyed audio output" of 1200 cycles (nominal) at a voltage output level of .050 volts intended for insertion in microphone input on SSB transmitters, or AM transmitters operated above 50.0 Mcs. for MCW service.

II CIRCUIT DESCRIPTION

For the purpose of understanding how the CODAX operates, a simplified waveform diagram and block diagram are shown in Figures 1 and 2. The complete schematic is given in Figure 3.



The Key, either DOT or DASH, starts the blocking oscillator running at a frequency determined by the setting of the SPEED control potentiometer. The output of the blocking oscillator is a series of pulses (A). See Fig. 2. These pulses feed flip flop #1, which generates a DOT and a space (B) which goes into a summing circuit and then to the REED Relay Driver (E) that operates the relay at the keying rate. When it is the DASH paddle that is operated, the dot pulses are shaped and inserted into a second flip flop (D) which operates at half the frequency of the dot pulses. Its output, which is a pulse twice the length of the dot pulse, is passed through the gate which is opened by the dash paddle and is added to the DOT output in the summing circuit. The relay driver, in addition to operating the REED Relay, also operates an audio oscillator from its collector to provide the keyed audio outputs for monitoring in the mixer, and for insertion into the normal microphone input circuit of an AM or SSB transmitter. Both spacing ratios, and dot to dash ratios, are fixed for all speeds of operation. There is no waiting to "catch" the oscillator since the oscillator is always off until either paddle is pressed. Both DOTS and DASHES are self-completing and a dash may be inserted into a series of dots at any time by pressing the DASH PADDLE. The speed control knob carries an approximate speed calibration for operator convenience.

Power to operate CODAX is from six internally mounted mercury batteries (Mallory ZM-9) not furnished with the unit. Battery life will be in excess of 400 hours.

III MATERIAL PROVIDED

- 1) CODAX Automatic Keyer and attached cables.
- 2) Installation and operating instructions.
- 3) Warranty Card.

IV INSTALLATION

- 1) Open CODAX by removing two screws at rear of case. Slide case off to expose circuit board. Install six batteries making certain to observe polarity (+ and -) on both the batteries themselves and the battery holders. Note that with Mercury batteries the battery case is (+) and the tip is (-). The positive terminal of each holder is marked with red.
- 2) Plug cable marked "To Phone Jack" with standard phone plug into receiver headphone jack.

3) Plug your headphones into jack marked "Head Phones" on rear of CODAX.

4) (a) SSB or AM

Attach appropriate plug (to match your microphone plug) to cable marked "Keyed Audio". Insert this plug into transmitter microphone input. Disregard cable marked "To Key Term" (The REED Relay output). Using SSB with VOX, adjust VOX hold-in time to suit your operating speed. When the key is pressed for either dots or dashes, the VOX relay actuates the transmitter and mutes the receiver. Adjust receiver audio level and CODAX audio level for comfortable headphone level of both CODAX and the incoming CW signal. Set speed control to desired transmitting speed. Markings on this knob are approximate and are for reference only.

Adjust transmitter microphone gain so that on continuous dots at speed of 20 words per minute, the average final plate current is about 50% of the tuned up, loaded, full carrier value. If used with an AM transmitter (only above 50 megacycles) external change-over switching from transmit to receive will be required. Transmitter microphone level should be set to avoid over modulation in same manner as used for voice transmission.

(b) CW Transmitters - Disregard Cable marked "Keyed Audio Output"

Connect cable marked "To Key Term" to normal transmitter key terminals. The REED Relay will handle only 15 watts of total power (keyed voltage times keyed current equals keyed watts, 15 maximum). Refer to transmitter Instruction Manual to determine type keying circuit and maximum voltage and current to be "keyed". The maximum voltage is 250 volts and the maximum current is 1000 milliamperes, but note that you may not switch more than 15 watts. In general, blocked grid circuits will be found to be within acceptable limits ... but don't take chances - check and measure! If your keying circuit is beyond this 15 watt limit, or 250 volts, or 1000 Ma., obtain an external keying relay that will handle the power and use CODAX REED Relay Output to control the external relay. If in doubt, we recommend that you write to our factory Amateur Service Department for "specific" connection information including in your letter complete information on make, model, and, if possible, instruction book on your particular transmitter.

V PADDLE ADJUSTMENT

Each paddle is individually adjustable for both gap and tension. There are two screws visible at the top of the trim strip around the paddles. These are the individual adjustments for the spacing of the contacts. The two screws in the paddles themselves are used to adjust the tension of the paddles. The two adjustments are somewhat inter-dependent. It is suggested that the tension be set first and then the spacing adjusted as desired.

VI NOTES

- 1) CODAX Automatic Keyer does not by itself provide "break-in" keying. It will, however, usually work break-in, if break-in operation was provided initially in your transmitter installation.
- 2) Since CODAX is a solid-state device, it is well to make certain that the case of CODAX is grounded to your transmitter so that stray RF pick-up is avoided in the transistors.
- 3) CODAX makes a convenient device for tuning transmitters at high power levels when long tune-up time could injure tubes. The keyed output reduces the duty cycle during tune-up.
- 4) If Mercury batteries are not available, standard pen-light carbon zinc cells may be used but OBSERVE polarity when inserting ANY BATTERY. Mercury cells are positive case, negative tip --- carbon zinc cells are negative (-) case and positive (+) tip. We recommend Mercury cells for longer life and constant voltage.
- 5) If you are left-handed, the double paddle can be reconnected to reverse dot and dash levers by interchanging the two wires (white with orange tracer, and white with green tracer) which will be found attached to either side of the paddle assembly inside the case.
- 6) For additional information on Keying circuits, see Radio Amateur's Handbook - Section "Keying and Break-in".
- 7) If desired, the high speed limit of 50 words per minute may be increased to 65 words per minute by shunting R-3 with 47K ohms, 1/4 watt.

WARRANTY

Standard Electronic Instrument Warranty

Each instrument, or part, thereof, sold by Waters Manufacturing, Inc. is warranted to be free from original defects in material and workmanship.

The obligation under this warranty is limited to the repair or replacement of any instrument or part thereof, except tubes, semi-conductor devices, and batteries, which shall, within the period of 6 months from the shipment to the original purchaser, prove upon examination by Waters Manufacturing, Inc. to have become defective through normal use or handling, providing further that the original customer has filled out and returned the Warranty Record Card to the manufacturer within 10 days from date of purchase.

In all cases where service or adjustment is required, please write first to the factory, giving full information concerning the nature of the failure, including type and serial number of the equipment. Written procedure for returning the instrument to the factory will be given.

The right is reserved to change the published specifications of equipment at any time, and to furnish merchandise in accordance with current specifications, without incurring any liability to modify equipment previously sold, or to supply new equipment in accordance with earlier specifications.

Factory Service

If factory service is desired, a reasonable service charge will be made on any WATERS Communications products returned to the factory. On units returned within the warranty period, no charge will be made if the problem is judged to be of a "warranty" nature.

Units that have been modified, tampered with, or otherwise damaged by unauthorized persons or methods, will be repaired or serviced only at the expense of the user.

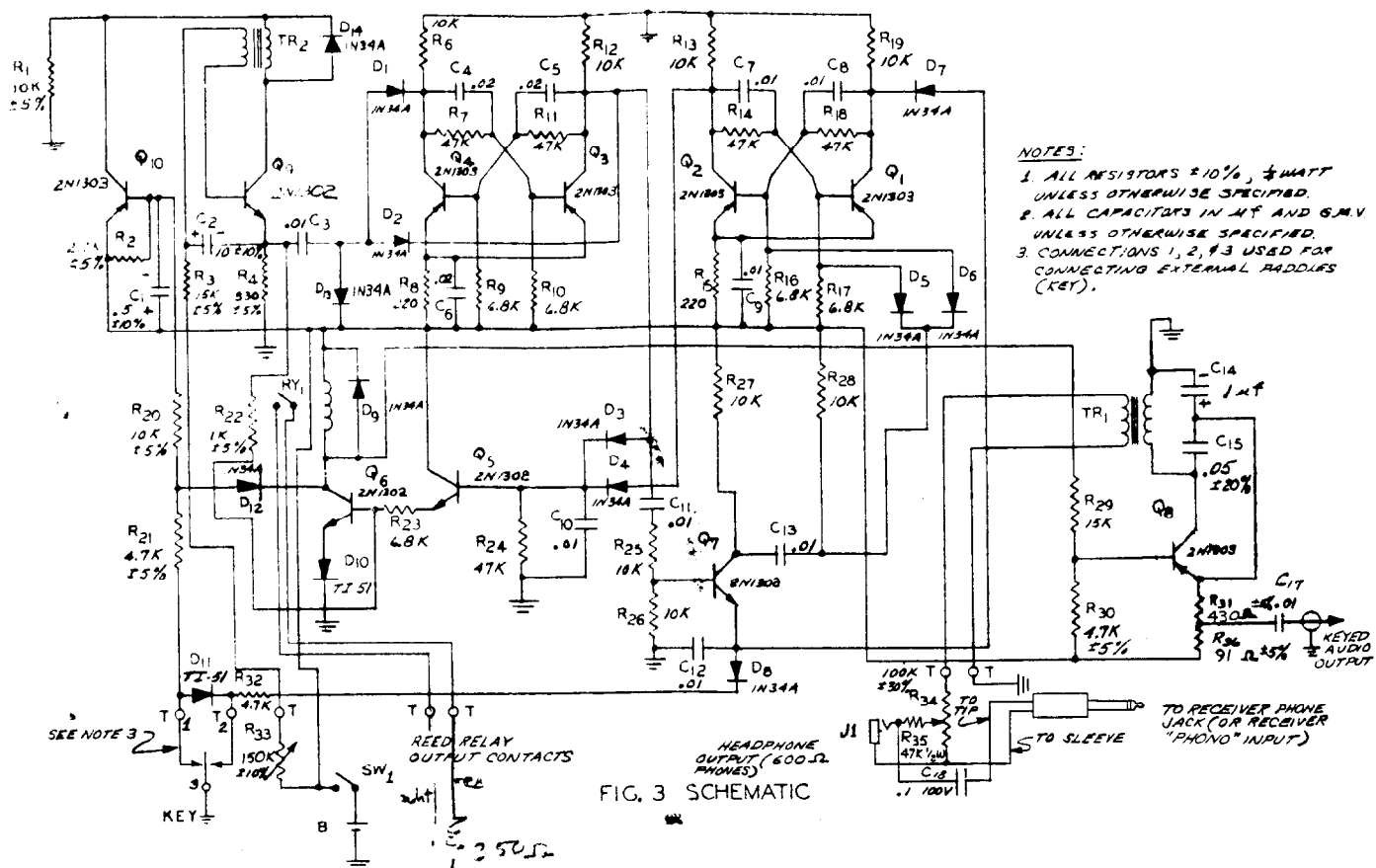
ADDENDA

1) Specifications

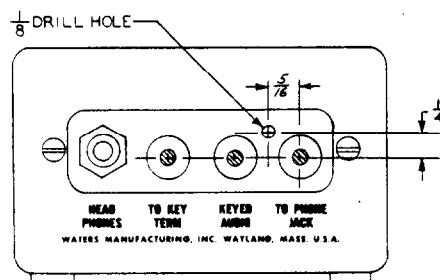
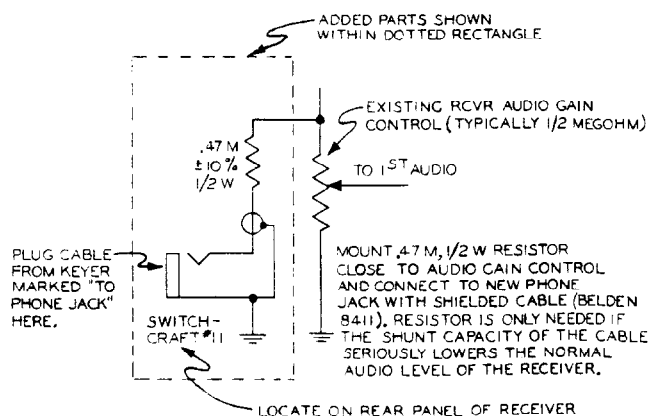
Audio Input -	1/2 watt (maximum) at 4 to 500 ohms.
Headphone Output -	(Adjustable) 0 - .2 volts into 600 ohm phones.
Keyed Audio Output -	.050 volts, 1200 c.p.s. nominal.
Reed Relay -	15 watts (maximum) 250 volts, 1 ampere (see text).
Paddle Pressure/Gap -	Factory adjusted to 20 grams at .001" (nominal) gap.

2) Additional Notes

- a) Keying - Where possible, it will always be preferable to use the Reed Relay contacts to key the transmitter.
- b) Loudspeaker Operation - The addition of a simple "phono" input to ANY communications receiver (see Fig. 4) will provide speaker operation AND headphone operation, as well as audio mixing of incoming signals and CODAX monitoring signal.
- c) Use of External Key - If it is desired to use an external key in place of CODAX paddles, a 3-wire cable can be installed easily in CODAX to use to connect an external key (Fig. 5).
- d) Use of CODAX Paddles - With the light pressure required to operate CODAX, no trouble will be encountered with CODAX "walking" on the table. If CODAX walks, you are not operating properly. Put your hand on the table and operate the paddles using only light FINGER pressure of the thumb and index finger ... no wrist or arm movement to be used. Give yourself and CODAX a little practice!
- e) Keyed Audio - When VOX CW with SSB transmitters is used, keep the transmitter microphone gain control turned down so the AVERAGE transmitter plate current is no more than 1/3 to 1/2 the "loaded" value on a string of fast dots.



M-A361-27/AA/1/65



M-A361-33/0/1-65

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WAYLAND, MASSACHUSETTS

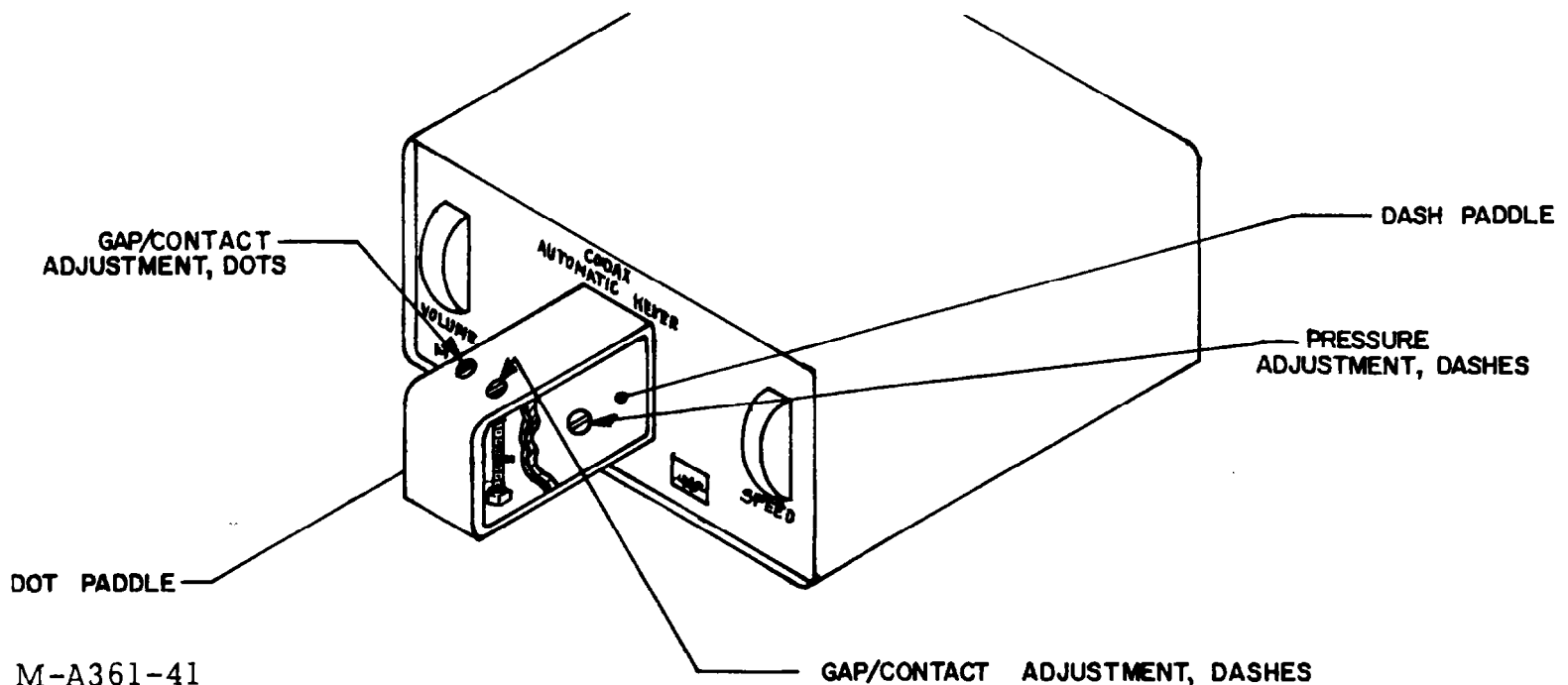
MODEL 361 - CODAX AUTOMATIC KEYS
SUPPLEMENTAL INFORMATION
PADDLE ADJUSTMENT

Now that we have delivered a sizable number of CODAX Keyers to satisfied customers, we find that there are still those who do not understand how to adjust the paddles for individual "feel".

Each of the two paddles is individually adjustable for BOTH contact gap and pressure. They are set at the factory for a gap of about .001" and a pressure of 20 grams. Since there are those customers who want to reset the paddles to their own "specs", here is the information.

Each paddle consists of a beryllium copper spring plate, covered with a decorative red plastic handle. A Pressure Adjustment screw is mounted on each paddle. Turning this screw counterclockwise decreases the pressure by reducing the initial deflection of the spring. Located on the top surface of the dress channel are two contact gap adjustment screws. Within reasonable pressure limits, it is possible to obtain a practical gap adjustment.

First, adjust the pressure screw for a comfortable amount of pressure when you press the paddle lightly. Now, with a small instrument type of screwdriver, carefully turn the gap screw until a continuous string of dots (or dashes) is heard. Next, back off on the contact gap screw until first the dots stop AND the gap "feels" correct. If the pressure is now slightly off, make a small correction in the setting of the pressure screw. Realize that there is necessarily an interaction of these two adjustments and that, therefore, moving one screw will cause a change in the adjustment of the other screw. It may be necessary, therefore, to arrive at the final adjustment by a series of small back and forth adjustments.



M-A361-41
March 1967

SUPPLEMENTAL INFORMATION AND MODIFICATION BULLETIN

MODEL 361 - CODAX AUTOMATIC KEYS

STICKING CONTACT IN REED RELAYS

A number of customers have reported to us that when the CODAX Keyer is connected to use the blocked grid keying circuit in National transceivers that after a short time the Reed contacts in the CODAX keying relay stick in the closed position. This has prompted us to go back and re-examine the circuitry of all transmitters available that have blocked grid keying provisions. We have found that many transceivers and transmitters bring out the lead from the keying circuit to a terminal at the rear of the transmitter. This lead is then by-passed by a small value ceramic capacitor usually .01 in order to prevent stray R.F. from getting back into the grid circuit of the keyed stage. Although the DC voltage and currents measured in these circuits appear to be within the published limits of the Reed relay (15 watts maximum and 250 volts and 1,000 milliamperes), it should be realized that when the relay contact is made, the by-pass capacitor in the transmitter is discharged across the contacts of the Reed. The surge of current during this extremely short discharge cycle is greatly in excess of the maximum capability of the Reed and will result in a heating, arcing, and ultimately welding together of the Reed contacts. The current surge cannot be measured with a meter. A high-speed oscilloscope is needed for this measurement. The problem may be eliminated in practically all applications we have seen simply by connecting a 1/2 watt carbon resistor of at least 200 ohms in series with the output lead from the Reed relay to the blocked grid keying terminal on the transmitter. This resistor will limit the current surge during the discharge time of the capacitor.

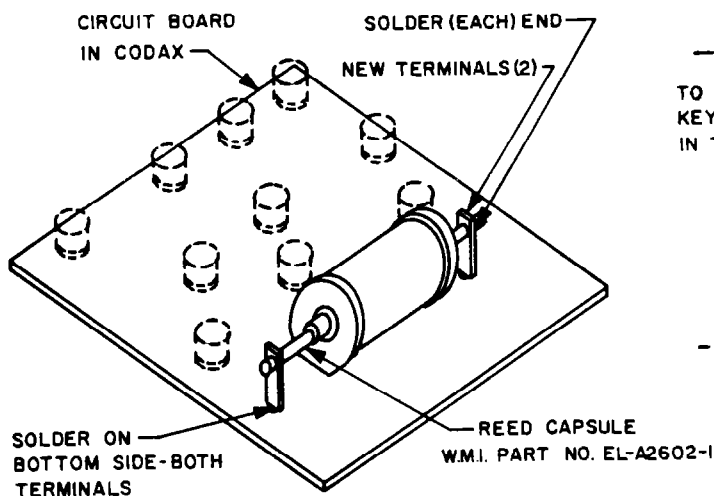
It is not recommended that this resistor be added internally because of the difficulties of field modifications to printed circuit boards. Subsequent manufacturing lots of CODAX Automatic Keyers will incorporate the addition of this resistor internally. At the same time, a change will be made in the mounting of the Reed relay to permit easy replacement of the Reed without removing the Reed solenoid.

In cases where difficulties have been encountered in the field with Reeds sticking, a Modification Kit comprising a new Reed with straight leads, 2 flexible terminals, and a 330 ohm, 1/2 watt resistor, is available as WATERS Part No. M-A361-36. These kits may be ordered at a price of \$3.00, postpaid in U.S.A. If only the Reed capsule is needed, order the above Kit. It is not recommended that this modification be made unless difficulty has been encountered with the original Reed relay. It is recommended that the 330 ohm resistor be added in all installations where the Reed relay contacts are used to key a bias circuit. The resistor is furnished with each CODAX Automatic Keyer for external mounting.

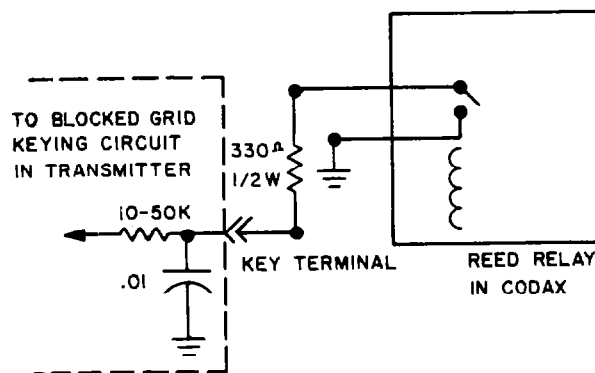
REPLACEMENT OF REED RELAY CAPSULE

Modification Kit M-A361-36

- 1) Using diagonal cutters, cut the Reed leads at each end of the Reed before the 90° bend.
- 2) Remove the Reed, saving the piece of foam plastic in the coil.
- 3) Using a soldering iron and long nose pliers, remove the vertically standing relay leads from the circuit board, and clean the holes of solder.
- 4) Insert new straight lead Reed into the solenoid using foamed piece to keep Reed tight in hole.
- 5) Attach terminals to each Reed lead - solder.
- 6) Insert free end of each terminal into the two holes in board (from Step 3), bend over leads on bottom side of board and solder. Note that some slack should be left in each of these terminals to avoid pressure on the Reed capsule leads.



**MODIFICATION KIT M-A361-36
FOR
CODAX AUTOMATIC KEYS
(TO PERMIT CHANGE OF REED RELAY CAPSULE)**



**TYPICAL KEY TERMINAL
USED IN MANY TRANSMITTERS
AND TRANSCEIVERS**